

Fuel Ethanol In Hawaii: A Historical Perspective



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**U.S. Department of Energy
Ethanol Workshop**



*Ethanol Fuel:
Coming Soon to a Car Near You*



**Honolulu, Hawaii
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Historical Perspective

- Early ethanol fuel use
- Notable non-fuel uses
- Chronology of ethanol fuel use
- Past problems experienced in Hawaii
- Typical types of problems reported
- Possible causes and solutions
- Simple steps to eliminate problems



Early Ethanol Fuel Use

- Maui Agriculture Co. (Paia mill) built the first distillery in U.S. to produce ethanol from molasses for fuel use in 1917!
- Ethanol used to operate cars, trucks, and camp stoves during WWI.
- Continued to use ethanol fuel until 1922(?) when gasoline and kerosene supplies became cheaper and more consistent.



Notable Non-Fuel Uses

- Seagram's constructs a distillery at HC&S Puunene (Maui) to produce rum in 1963. Rum is sold under the Leilani brand.
- Distillery closes in 1969.
- A&B acquires distillery in 1976.
- A&B sells facility to Maui Distillers in 1980 to produce "Hana Bay" and "Whaler's" brand rum.
- Closed in 1986.
- Hawaiian brand rums still exist today.



Chronology of Ethanol Fuel Use

- Worldwide oil shortages causes gasoline prices to skyrocket in 1970s.
- Midwestern farmers focus on using corn to produce ethanol as a gasoline “extender.”
- Various studies in Hawaii focus on using ethanol from molasses to accomplish same thing.
- Local sugar industry is optimistic and invests heavily into research in this area.
- HSPA (now HARC) studies indicate profitability of producing ethanol from molasses will rely heavily on government incentives.



Chronology of Ethanol Fuel Use

- Aloha Petroleum imports ethanol to blend with gasoline and begins marketing “gasohol” in 1979.
 - ◆ *Hawaii is a national leader by being one of the first locations to offer gasohol to the general public.*
 - ◆ *Customer problems attributed to gasohol arise immediately. (Discussed in more detail later)*
- In 1979, A&B and Maui Distillers agree to reopen Maui distillery to produce ethanol for both fuel and alcoholic beverages.



Chronology of Ethanol Fuel Use

- In 1980, the legislature contemplates a \$0.06 per gallon tax to underwrite construction of a \$40 million fuel ethanol plant. Proposal goes nowhere.
- C. Brewer (now BEI) completes a feasibility study in March 1981 to build an 11.4 million gallon per year molasses to ethanol plant on Big Island. Plans to build the facility continue to move ahead.
- Nationally, average retail gasoline prices peak at \$1.94 per gallon in 1981.



Chronology of Ethanol Fuel Use

- State demonstrates a 10% ethanol blend in DAGS fleet in early 1981.
 - ◆ *Conducted between February and May 1981*
 - ◆ *Involved 127 vehicles (1972 to 1980 model years)*
 - ◆ *Over 348,000 miles*
 - ◆ *No unusual problems noted*
- Average national gasoline prices begin to drop in 1982.



Chronology of Ethanol Fuel Use

- Aloha Petroleum discontinues their 2.5 year-old gasohol program in 1982.
 - ◆ *Weak demand and less overall interest spur decision.*
 - ◆ *Overall program was not doing well financially.*
- By 1984, the average national gasoline price had dropped over 22% from the 1981 peak.
- C. Brewer decides to cancel plans to build Big Island ethanol plant in 1984.
 - ◆ *Unable to finalize long-term ethanol purchase agreement with local refineries*
 - ◆ *Unable to justify investment since they do not directly market gasoline*



Chronology of Ethanol Fuel Use

- Pacific Ethanol Products builds a small ethanol production facility on Oahu in 1985.
 - ◆ *Molasses obtained from Oahu Sugar.*
 - ◆ *Completed by end of 1985 to obtain federal tax credits.*
- Nationally, U.S. EPA mandated phase-down of lead levels in gasoline reaches 0.1 gram per gallon. Alternative octane enhancers, including ethanol, gain favor.
- In 1986, Aloha Petroleum imports ethanol to blend and market an “ethanol-enhanced” unleaded fuel.



Chronology of Ethanol Fuel Use

- State again demonstrates a 10% ethanol blend in the DAGS fleet in late 1986.
 - ◆ *Uses only Hawaii-produced, molasses-derived ethanol from Pacific Ethanol Products.*
 - ◆ *Problems with vapor lock on about 1% of fleet every week.*
 - ◆ *Vapor pressure of blend was found to be excessive. Can be corrected with proper blending.*
- By 1987, national average gasoline price had dropped to \$1.10 per gallon.



Chronology of Ethanol Fuel Use

- By the late 1980s, Pacific Ethanol Products was the only entity offering ethanol for fuel blending in state.
- Many of the economic incentives driving the production of ethanol in Hawaii were gone.
- Due to naturally clean air, Hawaii was not mandated to reduce CO emissions through use of oxygenates (e.g., ethanol, MTBE)
- National average gasoline price was under \$1.06 per gallon by 1993.



Past Problems Experienced in Hawaii

- There were problems reported by automotive service technicians believed to be related to the use of gasoline blended with ethanol.
- Mostly anecdotal.
- Controlled studies showed few of these same problems (e.g., State DAGS fleet, 1981).
- Very few problems ever reported regarding engine power, mileage, or performance.
- Similar problems were initially seen in other U.S. mainland locations and have been overcome.



Typical Types of Problems Reported

- Deterioration of rubber components in carburetors, fuel lines, and fuel pumps.
- Fuel filter plugged with debris.
- Vapor lock.
- Water in fuel line.



Possible Causes and Solutions

- Deterioration of rubber components in carburetors, fuel lines, and fuel pumps.
 - ◆ *Appeared to only affect certain makes and models of vehicles.*
 - ◆ *Components in newer vehicles have been updated and are fully compatible.*
 - ◆ *All vehicle warranties now cover use of ethanol blended fuel.*
 - ◆ *Most older cars have already had these parts replaced with newer materials.*



Possible Causes and Solutions

- Fuel filter plugged with debris.
 - ◆ *No evidence that ethanol contained debris.*
 - ◆ *Ethanol has inherent solvent and detergent qualities. If any system is dirty (i.e., vehicle fuel system, UST at dispensing location, transport truck, etc.), the addition of ethanol may loosen and suspend this debris.*
 - ◆ *Fuel systems on newer vehicles very clean.*
 - ◆ *More detergents being used in gasoline now than previously.*
 - ◆ *Filter is doing its job.*



Possible Causes and Solutions

- Vapor lock.
 - ◆ *Can be caused by high vapor pressure or a high vapor/liquid ratio of the fuel.*
 - ◆ *Ethanol has a high vapor pressure and raises the vapor pressure of the blended fuel.*
 - ◆ *Current formulation of gasoline refined in Hawaii has a vapor pressure too high to allow direct blending with ethanol without exceeding the U.S. EPA maximum vapor pressure parameter.*
 - ◆ *Blending ethanol with gasoline refined in Hawaii would necessitate refiners to reformulate the vapor pressure or their gasoline.*



Possible Causes and Solutions

- **Water in vehicle fuel line**
 - ◆ *Water may have come from vehicle's fuel tank or the gasoline UST.*
 - ◆ *Water in vehicle's fuel tank*
 - *Extremely rare to have water in fuel system in newer vehicle.*
 - *If older vehicle has water in fuel tank, addition of ethanol may move water into fuel line.*



Possible Causes and Solutions

- **Water in vehicle fuel line (continued)**
 - ◆ *Water in gasoline UST*
 - *Older gasoline USTs may have contained water. This water may have mixed with the ethanol and caused water to be transferred to vehicle.*
 - *Hawaii Department of Health UST program became operational in 1986. UST operations are now regulated to a much higher degree than before.*
 - *Critical that USTs must be free of water before ethanol blends are added. However, once UST is free of water, ethanol blend will keep UST water free.*
 - *Normal practice now to place a filter on dispensing pump to prevent transfer of any free water in UST to vehicle. This was not a common practice previously.*



Simple Steps to Eliminate Problems

- Be certain that gasoline USTs are free of any free water before being used for ethanol blends.
- Work with refiners to obtain gasoline with the correct vapor pressure so that ethanol can be blended without exceeding U.S. EPA maximums.
- Install filters on dispensing pumps to remove free water.
- Be prepared to replace some rubber seals, etc. on older and vintage vehicles.



Ethanol In Perspective... Then and Now

THEN

- Used as a gasoline “extender”
- Octane boost came from lead
- Very few concerns of gasoline’s effect on air quality
- Very little experience with ethanol blends
- Vehicle manufacturers generally not supportive



Ethanol In Perspective... Then and Now

NOW

- Used as a gasoline extender, oxygenate, and octane booster
- Used in more than 40 states
- ALL automobile manufacturers approve of use of E10
- Strong Federal and State support for reasons of economic and energy security
- Clearly defined handling and storage standards based on “real world” experience

